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Northern New Mexico College	Northern New Mexico College 921 Paseo de Onate Espanola, NM. 875322649
AWARDEE ORGANIZATION CODE (IF KNOWN) 0002378000	
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IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions) ☐ SMALL BUSINESS ☐ FOR-PROFIT ORGANIZATION ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS ☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **NSF INCLUDES: Northern New Mexico STEM Mentor Collective**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 299,776	24 months	10/01/16	1641661

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW
☐ BEGINNING INVESTIGATOR (GPG I.G.2)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date ______
PHS Animal Welfare Assurance Number ______
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☒ COLLABORATIVE STATUS
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CO-PI/PD [redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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CERTIFICATION PAGE

Certification for Authorized Organizational Representative (or Equivalent) or Individual Applicant

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), drug-free workplace, debarment and suspension, lobbying activities (see below), nondiscrimination, flood hazard insurance (when applicable), responsible conduct of research, organizational support, Federal tax obligations, unpaid Federal tax liability, and criminal convictions as set forth in the NSF Proposal & Award Policies & Procedures Guide,Part I: the Grant Proposal Guide (GPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of AAG Chapter IV.A.; that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

Drug Free Work Place Certification

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent), is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

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This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:
(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.
(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

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By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:
(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:
(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
(2) for other NSF grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)
(This certification is not applicable to proposals for conferences, symposia, and workshops.)

By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research.
The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

CERTIFICATION PAGE - CONTINUED

Certification Regarding Organizational Support

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Federal Tax Obligations

When the proposal exceeds $5,000,000, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal tax obligations. By electronically signing the Certification pages, the Authorized Organizational Representative is certifying that, to the best of their knowledge and belief, the proposing organization:
(1) has filed all Federal tax returns required during the three years preceding this certification;
(2) has not been convicted of a criminal offense under the Internal Revenue Code of 1986; and
(3) has not, more than 90 days prior to this certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

Certification Regarding Unpaid Federal Tax Liability

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal Tax Liability:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

Certification Regarding Criminal Convictions

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Criminal Convictions:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has not been convicted of a felony criminal violation under any Federal law within the 24 months preceding the date on which the certification is signed.

Certification Dual Use Research of Concern

By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME [redacted]	Electronic Signature	Jun 24 2016 2:52PM

TELEPHONE NUMBER	EMAIL ADDRESS	FAX NUMBER
[redacted]	[redacted]	[redacted]

PROJECT SUMMARY

Overview:

Our colleges serve a rural indigenous community, 18% Native American and 82% Hispanic, which is traditionally suspect of outside intervention. One tragic consequence of this cultural isolation is a lack of educational attainment, which in turn has diminished the educational aspirations of the young. This is especially pernicious as regards STEM, for none of the majority indigenous high schools in the region bring more than 6% of their students to grade level in mathematics. Northern New Mexico College (NNMC) and the University of New Mexico at Los Alamos (UNMLA), using affordable, practical, technology oriented STEM Certificates, Associates and Bachelor degrees, with the assistance of important community partners, have succeeded in attracting and training over 150 indigenous STEM majors. These students recognize that their success in these programs offers them the potential to break the cycle of low educational aspirations in their communities. Our proposal is to empower these indigenous STEM undergraduates, to support them as role models and STEM mentors, and to create settings in local high schools and libraries where they engage in the sustained STEM interactions necessary to build trust that opens the door to real influence. We propose to build, nurture, and dispatch an indigenous STEM mentor corps. By changing attitudes in local communities and heightening a sense of self-efficacy, we expect this corps to permanently increase the flow of the state's indigenous populations into STEM majors and careers. The crux of our project is the establishment of a STEM Mentoring Collective capable of training, placing, supporting, and assessing the impact of STEM mentors. While our two colleges have the resources and expertise to provide STEM content training, we require regular and sustained contact with: (1) front line high school teachers and community librarians in order to align STEM content and interactive explorations to the intended audience, and (2) community partners at The Center for the Education and Study of Diverse Populations, Los Alamos National Laboratory, Los Alamos National Laboratory Foundation, Regional Development Corp., and Science Education Solutions Inc. in order to capitalize on their ability to both engage K-12 communities in STEM and to quantify the factors that had the greatest impact on participants. Our proposed Collective consists of 21 individuals from two colleges, three high schools, two libraries, one science museum and five community partners. All are within thirty miles of the Collective's Backbone, the NNMC main campus in Espanola. Together we will continuously improve six tightly coupled programs: three bringing indigenous STEM mentors to students, one training mentors, one training mentees to value and grow their network of mentors, and one training teachers to partner with us in STEM.

Intellectual Merit :

The intellectual merit of our project lies not only in its assertion that authentic STEM mentors will exert an outsize influence in their communities while increasing their own sense of self-efficacy, but in the creation and careful application of instruments that assess the factors that determine teens' attitudes, career interests, and behaviors toward a STEM future; and mentors' sense of self development and progress through STEM programs. More precisely, evaluation of the programs has the potential to clarify two important questions about the role of college-age mentors in schools: (1) To what degree is the protege's academic performance and perceived scholastic competence mediated by the mentor's impact on (a) the quality of the protege's parental relationship and (b) the social capital of the allied classroom teacher; (2) To what degree does the quality of the student mentor's relationships with faculty and peers mediate the impact of her serving as mentor on her self-efficacy, academic performance, and leadership skills?

Broader Impacts :

The broader impact of our project lies in its potential to focus the talents and energies of a diverse collective of community stakeholders on the empowerment of its local college population to address and solve a STEM disparity that bears directly on the community's well-being - in a fashion that is generalizable to other marginalized communities. Our STEM Mentor Collective is generalizable because with only a moderate initial investment our disseminated 6-program infrastructure supports the growth and maintenance of a realistic homegrown mentor corps.

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For font size and page formatting specifications, see PAPPG section II.B.2.

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

Project Description Northern New Mexico STEM Mentor Collective

Our goal is to establish and pilot a network of local partners capable of achieving quality collective impact, as defined by [EH] in the context of the StriveTogether network [KK], in addressing the societal roots of a deep persistent STEM deficiency in Northern New Mexico. We will accomplish this by implementing a local adaptation of the **Theory of Action** articulated in [EH]. Namely, we will **Engage our Community Partners** to **Focus on Eliminating Locally Defined Disparities** by **Leveraging Existing Assets** in a fashion that **Develops a Culture of Continuous Improvement.**

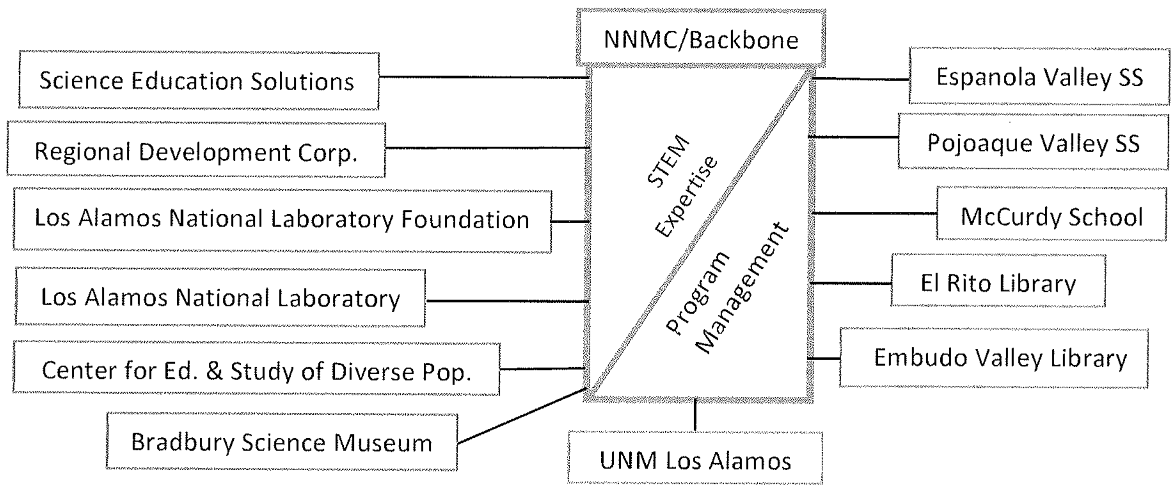

Figure 1. The Organizations that comprise the Northern New Mexico STEM Mentor Collective.

The **Community Partners**, illustrated in the figure above, cluster naturally into three distinct Student Support Networks (SSNs). At the right, with orange borders, we have an SSN comprised of key representatives of three local public school systems and two rural libraries. At the center, with green borders, we have an SSN comprised of key representatives of the two regional, STEM degree (up to Bachelors at Northern New Mexico College (NNMC) and up to Associates at the University of New Mexico at Los Alamos (UNMLA)) awarding public institutions. At left, with blue borders, we have an SSN comprised of key representatives of six local organizations committed to both youth development and STEM education. Biosketches for the twenty one representatives from the thirteen organizations in our three Student Support Networks have been included with this proposal. Their roles within and without their respective SSNs will be made precise in coming sections of this proposal.

The **Disparity** that our three SSNs will collectively tackle is the persistently low level of math and science attained by the vast majority of our local high school graduates. This performance essentially precludes these students from the pursuit of STEM majors and STEM careers.

The **Local Assets** that we will **leverage** are our existing STEM undergraduates at NNMC and UNMLA. Through a combination of technology based programs, well-tailored curricula and engagement with several of the partners in Figure 1, NNMC and UNMLA have succeeded in attracting a number of local STEM majors sufficient to establish a self-sustaining mentor corps. These mentors will act as role models in the front line, shoulder to shoulder with caring faculty and peers – serving both to inspire our school students to achieve greater preparation in STEM subjects and to nurture and so retain our existing STEM majors.

The **Development of a Culture of Continuous Improvement** will stem from our collective setting of agreed upon measures, our adherence to Evidence Based Decision Making, and our collaboration on locally tailored programs that transcend any one Student Support Network.

1. Our Setting and Our Response

New Mexico is one of only four states in the US that is "majority-minority," with Hispanics representing 48% of the total state population. NNMC meets the designation requirements for both Hispanic- and Native American-serving, with eight Indian Pueblos and the Jicarilla Apache Tribe (together constituting 18% of the population, versus 1.2% nationally) and widespread Hispanic communities (constituting 72% of the population, versus 17.1% nationally) within its service area.

Northern New Mexico is geographically spread over 9,700 square miles of rural and mountainous terrain. The region struggles with endemic poverty, a dearth of employment opportunities, and a marked underrepresentation in educational attainment, all contributing to severe socioeconomic challenges. The higher education research literature shows that first generation and low-income students are at much greater risk of not persisting and graduating from college. In Rio Arriba County, the largest county in the region, one in four residents lives in poverty (compared to 21.5% in New Mexico (NM) and 14.5% nationally), the per capita income is $19,483, and only 15.5% of the population has earned a bachelor's degree (compared to the national average of 29.3%). This has led to high regional rates of hardship: The Census Bureau ranks NM 49th in the US for children living in high-poverty areas; 72% of the population is eligible for SNAP benefits; and an average of 80.2% of students receive free and reduced lunches (compared to 62.9% in NM and 44.6% nationally). NNMC's majority of first generation (53%) and underrepresented minority population (77%) contributes to a higher percentage of academically underprepared students (83% average), compared to the national average (60%); low retention rates (50%) from first to second year; and a significantly lower graduation average (17%) compared to the 2014 national average (55%) for first-time, full-time students seeking a bachelor's degree at a 4-year institution and completing within six years. The large gap in college readiness is largely due to struggling regional K-12 public schools: 87% failed to meet the 2011 No Child Left Behind Adequate Yearly Progress; the large majority received a 'D' or 'F' in 2015 from the NM Public Education Department. NM ranked 50th in 2014 and 49th in 2015 in a report card that measures education performance across the nation; and the Quality Counts Report published by the Education Research Center issued New Mexico 'D's' in 2014 and 2015 on a student's chance for success, an index that measures the role of education from cradle to career.

This combination of poor preparation and cultural isolation has led to the perception that higher education, and STEM in particular, is neither open nor attractive to our community. This perception is tragically a self-fulfilling prophecy, for early work ([SS], [SHP], [WH]) with rural high school seniors found that the influence of socioeconomic status on educational aspirations is almost wholly mediated by the expectations of *significant others*. In our impoverished culturally isolated community our teens typically grant real significance to *only* those that share their struggle and culture.

We **propose** to counter this STEM disparity by creating guided, immersive, sustained interactions between local teens and trained *authentic STEM mentor role models* from the small, fragile, but growing ranks of STEM undergraduates at NNMC and UNMLA. Our undergraduates are authentic, or significant, in the sense that they are alums of the exact schools we wish to serve. To accomplish this we will create, and continuously improve, two sets of programs. The first set is comprised of direct attempts to engage youth in sustained interactions with trained STEM mentor/role models:

1. **STEM Explorations**, College Faculty and trained undergraduate mentors serving school students in four areas: Biology, Computing, Robotics and Mathematics. Each subject to be offered in six consecutive weekly in school classes.
2. **STEM Summer Bridge**, College Faculty and trained undergraduate mentors serving school students. Same subjects as above, but now each six week exploration is offered over one week of daily meetings.
3. **STEM Collaboratives**, trained undergraduate mentors and local teachers and librarians recruiting youth to increase local STEM knowledge and address local STEM challenges.

The second set of programs are meant to prepare college students to become mentors, prepare youth to value and seek mentors, and help school teachers and librarians work more closely with STEM college students and faculty:

4. **STEM Mentor Training Course**, a 7 week credit bearing college course serving undergraduate STEM majors at NNMC and UNMLA. Offered each semester. Designed and implemented by representatives from all 3 SSNs.
5. **Expand Your Network of Caring Adults**, a 7 week program, offered each term in parallel with the STEM Mentor Training Course, which provides High School Students with strategies for valuing and acquiring caring mentors. Designed and implemented by representatives from all 3 SSNs.
6. **STEM Community Workshop**, a one-week course, serving STEM teachers and librarians, with the first full four days day devoted to subjects from our STEM Explorations, and the fifth day devoted to curriculum planning in schools and collaborative planning centered at community libraries. Designed and implemented by representatives from all 3 SSNs.

In coming sections we will detail the rationale and collective planning, execution and evaluation of each of these six programs.

2. The Promise of Mentoring

In this section we establish the rationale for our mentor collective and its six programs, with particular attention to evidence-based methods and quantitative measures, by examining the significant literature on:

1. The impact of adult mentors on school-age youth;
2. The impact that serving as mentors has on undergraduates; and
3. The impact that undergraduates have on teachers in grade schools.

2.1. Impact of Mentoring on Grade School Protégées

The importance of mentoring in the development of young minds from impoverished communities is difficult to overestimate. For example, Williams and Kornblum in an early influential text, [WK], observed that, "The probabilities that teenagers will end up on the corner or in a stable job are conditioned by a great many features of life in their communities. Of these, we believe the most significant is the presence of adult mentors," and Lefkowitz [Le] in a similar study of disenfranchised youth states, "Again and again, I found that the same pattern was repeated: the kid who managed to climb out of the morass of poverty and social pathology was the kid who found somebody, usually in school, sometimes outside, who helped them invent a promising future." These two quotations serve as clarion calls in the sweeping, yet measured, review of youth mentoring by Rhodes [Rh]. She understands that mentoring has received too little objective evaluation and fears that it has been uncritically overpraised. For example, early in the text she warns, "From personal experiences, observations, and research, I am convinced of the extraordinary potential that exists within mentoring relationships. But I have also encountered the harm – rarely acknowledged – that unsuccessful relationships can do to vulnerable youth." After documenting, over the next 100 pages, the rewards and risks of mentoring, with significant advice for program construction, management and evaluation, she puts mentoring in perspective, as of 2002, with the qualified recommendation, "At this stage, we can safely say that mentoring is, by and large, a modestly effective intervention for youth who are already coping relatively well under somewhat difficult circumstances. In some cases it can do more harm than good; in others it can have extraordinarily influential effects. The balance can, and should, be tipped toward the latter. A deeper understanding of nonparent adult relationships, combined with high quality programs and enriched settings, will better position us to harness the full potential of youth mentoring."

Beyond quality programs in enriched settings one goal of our network will be a deeper understanding of the relationship between our school-age protégées and our undergraduate STEM mentors. In particular, it is very important that we help the undergraduate mentor achieve the right balance of emotional support and academic support. For the observation by Theodore Roosevelt that "Nobody cares how much you know until they know how much you care," has been born out repeatedly in the mentoring literature. To wit, Styles and Morrow [SM] found that a trusting and consistently supportive mentoring relationship outweighed the mentor's focus on specific goals.

In order to quantify the mechanisms by which mentoring acts on youth Rhodes *et al.* [RGR], in a national study of Big Brothers Big Sisters, posit the pathways of Figure 2 in their hypothesis that the positive impact of mentoring on youth is largely mediated by improvements in parental relationships. They draw their hypothesis from the insights of attachment theory – according to which, [Ai], [Bre], children base future relationships on their early experiences with primary caregivers. These experiences are thought to establish a child's *working model* that then influences their engagement in interpersonal relationships throughout and beyond childhood. The plasticity of the child's working model is one of the central concerns of developmental psychology. Rhodes *et al.* [RGR] site evidence that engagement in an unconditionally supportive mentoring relationship has the capacity to change the protégée's working model. In particular, rather than mentors diminishing or even usurping the role of parents, [SM] discovered that adolescents who developed emotional bonds with their mentors gradually began to experience more positive, trusting interactions with both parents and peers. These insights then led Rhodes *et al.* [RGR] to hypothesize that "These positive changes in conceptions of relationships may also facilitate adolescents' capacity to use mentors as role models and to derive other cognitive and emotional benefits. By conveying messages regarding the value of school and serving as tangible models of success, mentors may stimulate adolescents' improved attitudes toward school achievement, perceived academic competence and school performance as well as adolescents' belief about the relationship between educational attainment and future occupational opportunities. To the extent the adolescents begin to place greater value on school as an important context for attaining future goals, they are expected to achieve, academically and behaviorally in that context. In addition, through their provision of emotional support and positive feedback, mentors are thought to enhance adolescents' self-concept which, in turn, is related to more positive perceptions of scholastic competence and to school related achievement and behavioral outcomes."

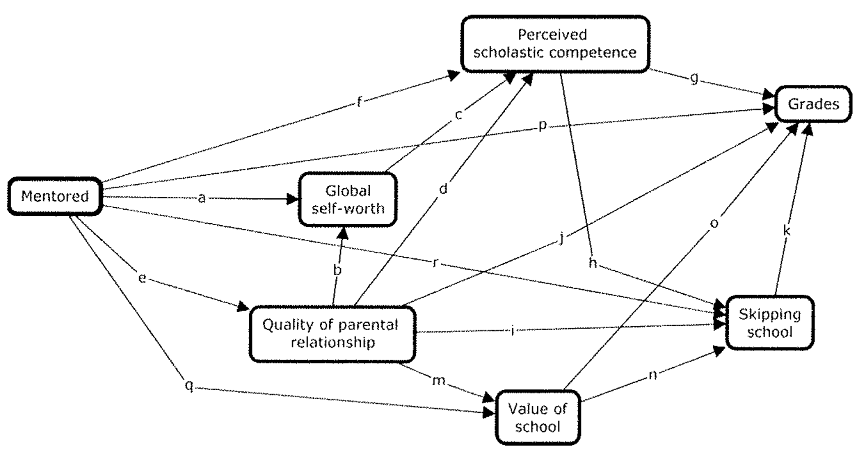

Figure 2. The model of mentor impact on academic adjustment of protégées.

Rhodes *et al.* [RGR] test these suppositions by measuring each protégée's:

P1. Parent Relationships, via the Inventory of Parent and Peer Attachment devised by [AG].

P2. Scholastic Competence, via a 6-item subset of Harter's Self-Perception Profile for Children, [Ha].
P3. Grades and Unexcused Absences, as reported by the protégée.
P4. School Value, via the 18-item measure of [BM.
P5. Self-worth, via a distinct 6-item subset of Harter's Self-Perception Profile for Children, [Ha].

We note that these measures do not collect information on the number and type of existing mentors. They also miss the protégée/mentor relationships, the shift in attitudes toward STEM learning and careers and do not consider factors unique to our targeted population. We can address several of these points by adopting measures from the study by Sánchez et al. [SEC] of the impact of natural mentors on the academic performance of Latino adolescents. In particular, we propose to adopt their measures of

P6. Identification of mentors.
P7. Characteristics of mentors.
P8. Characteristics of mentoring relationships.

Regarding the measurement of shift in STEM attitudes we propose to adapt measures constructed to evaluate two recent NSF STEM Workforce programs. The NSF GK-12 program challenged graduate students to inspire transformation in the K-12 formal and informal learning environments and stimulate interest in science and engineering among students and teachers. Degenhart *et al.* [Deg] developed a simple measure of the impact of the graduate students on the student participants. Our adaptation reads:

P9. Do you think you could become a scientist (or technologist, engineer, or mathematician) like your STEM mentor? Why?

The NSF ITEST (The Innovative Technology Experiences for Students and Teachers) program was established by the National Science Foundation in direct response to the concern about shortages of information technology workers in the United States. We plan to adopt two measures of ITEST impact designed and tested by Tyler-Wood *et al.* [T]:

P10. STEM Semantic Survey, a 25-item instrument that measures interest in STEM as well as interest in STEM careers more generally.
P11. The STEM Career Interest Questionnaire, a 12-item instrument that measures interest in careers in broad science areas.

With this emphasis on parental relationships our collective must also take into account the expectations that parents place on their children and their schools – especially to the degree that these differ from the dominant Anglo model. As an example of the former we recall the treatment of vergüenza by Kutsche and Van Ness [KV]. "In most of Hispanic America, *vergüenza* means little more than *shame*. This is only one of its meanings in New Mexico, where an accurate definition might be *tender regard for the good opinion of one's fellow citizens*. A child is born without vergüenza, and must be taught – even whipped, if necessary – so it will acquire this quality. Muchachos and jovenes who may decline to speak in public because of vergüenza – bashfulness or shyness – are considered modest and praiseworthy, while a shy Anglo youth would be urged to overcome his affliction." If vergüenza indeed translates into passivity in the classroom than we can expect this to effect mentoring relationships. To measure this we propose to append an item to the Scholastic Competence instrument in the language of [Har]:

P2'. Some teenagers know how to ask their teachers and parents for help BUT Other teenagers are embarrassed to ask for help.

Regarding the more general question of engagement of Latino families with the education system Hill and Torres [HT] note a significant mismatch in expectations. "Latino families define being "well

educated" more broadly than do U.S. schools. In addition to its academic components, for Latinos, *"educación"* encompasses being moral, responsible, respectful, and well behaved. Latino parents believe that they are responsible for developing these aspects of their children, which are the foundation of the academic education that is the schools' domain. Whereas much of the literature and policies on family–school relationships promotes "partnerships," Latino parents are often uncomfortable with the notion of being "equal partners" with teachers on the academic aspects of education, especially as they hold the profession of teaching and teachers in high esteem. Because of differences in beliefs about their respective roles, Latino parents often feel uncomfortable with the expectations schools have for them. Teachers and school personnel expect them to engage their children in ways that impact their home life and they feel that, if they did not comply, teachers would judge them negatively. Whereas they respect teachers' roles in school, they also expect teachers to respect parents' roles in the home. Latino parents hold teachers in high regard and believe that it is disrespectful to challenge teachers, so parents are often reluctant to express their opinions to teachers, especially if they disagree. They do not want to be disrespectful or disrupt the relationship with him or her. Latino parents do not want to interfere with the teachers' domain yet feel that their own authority at home is questioned." Hill and Torres [HT] go on to state that "additional effort is required to build the bridge between school expectations and culturally embedded beliefs." We contend that the broad collective effort proposed here – with its emphasis on strengthening and leveraging family ties – will assuage the teacher/parent anxiety present in the existing, dichotomous, partnership.

2.2. Impact of Mentoring upon the Undergraduate Mentors

The systematic introduction of undergraduates into middle and high schools, outside of those pursuing degrees or certification in Education, is relatively rare and poorly studied. The one exception being *Service Learning* – a college teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities. This general definition jibes with our goals for our mentors and for our mentor training program although we will *model* rather than *teach* civic responsibility and instead teach our mentors to be exemplary communicators of the wonders of STEM.

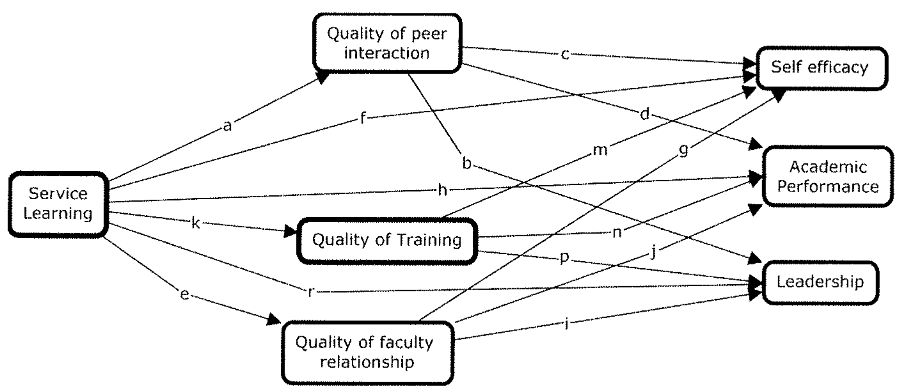

Figure 3. The proposed model of service learning impact on academic adjustment of mentors.

Astin *et al.* [AVIY], in a national study of service learning programs, explore both the effects of service learning on the cognitive and affective development of college undergraduates and the means by which learning is enhanced by service. They found significant positive effects on eleven measures using a combination of existing and custom instruments:

M1. Grades

M2. Writing skills
M3. Critical thinking skills
M4. Self-efficacy
M5. Leadership activities
M6. Self-rated leadership ability
M7. Interpersonal skills

We have, for illustrative purposes, lumped the first three outcomes into "Academic Performance" and the last three outcomes into "Leadership" in our model in Figure 3. In contrast to Figure 2 we now place Quality of Peer and Faculty Relationships in place of Quality of Parental Relationships – for the research of Astin *et al.* [AVIY] has identified peer and faculty relationships, as well as quality of the training course, to be significant mediators of the benefits of service learning. The value of the peer relationship was found to be largely dependent on the degree to which service learners shared their experiences with one another, while the value of the faculty relationship hinged on two distinct modes of support. Adapting their measures to our setting yields:

M8. To what extent did you "process" your mentoring experience with other mentors?
M9. To what extent did your faculty co-mentor lend you emotional support?
M10. To what extent did your faculty co-mentor lend you academic support?
M11. To what degree did the mentor training course prepare you for your experience?

Although the outcomes at the right in Figure 3 are not specific to STEM, progress in each of these three is surely consonant with one of our central concerns, advancement toward degree for our STEM mentors.

2.3. Impact of Undergraduate Mentors on Grade School Teachers

Noddings observation, [No2], that "Improved teacher morale and improved learning for all students go hand in hand," appears perhaps self-evident. The challenge then is to boost and sustain high moral. There is now a significant body of research, [LP], [PL] and [Sh], that derives heightened teacher moral from greater degrees of collaboration through a theory of social capital. This literature also provides quantitative confirmation of Noddings truism that students learn more from happy teachers. In particular [LP] show that "both internal social capital (relations among teachers) and external social capital (relations between the principal and external stakeholders) predict student achievement in mathematics and reading. These effects were sustained over time for reading achievement, providing support for a causal relationship between social capital and performance." Our personal experiences suggest to us that our collaboration with teachers in both the planning and execution of our palette of six STEM activities will increase their social capital. To evaluate this we will follow [LP] in their division of social capital into structural (information sharing), relational (trust), and cognitive (shared vision) facets and will adapt the associated measures:

T1. Information sharing, via the six items developed by Hyatt and Ruddy [HT].
T2. Trust, via six items developed by Pearce *et al.* [PBB].
T3. Shared vision, via two items from Tsai and Ghoshal [TG] and four from Sinkula *et al.* [SBN].

Evidence that increased teacher moral increases student learning permits us to couple the protégée model of Figure 2 with the mentor model of Figure 3. In particular, teacher collaboration with undergraduate mentors increases their social capital which then serves as an additional mediator in the protégée model between the mentor and youth grades, value of school and perceived scholastic competence. As we add school principals and superintendents to our mentor collective we expect to measure the associated external social capital of [LP].

3. The Backbone Institution and Qualifications of the Principal Investigators

The backbone institution of our collective, Northern New Mexico College (NNMC) is the oldest Hispanic serving institution in the country. Via a palette of affordable, practical, technology oriented STEM Certificates, Associates and Bachelor degrees, together with the assistance of a number of important community partners, NNMC has succeeded in attracting and training over 150 indigenous STEM majors.

[redacted] while at [redacted] University, was the co-director of an NSF VIGRE-1 award and PI of the subsequent NSF VIGRE-2 award. [redacted] directed this 10 years (2003-13) of funding of [redacted] postdocs, graduate and undergraduate students, in three departments and two schools, to eliminate the vertical stratification of mathematical research that NSF rightly identified to be to an obstacle to the commencement of mathematical research – especially for those from underrepresented populations. [redacted] designed and propagated a model for vertically integrated, credit bearing, problem based, research seminars that was adopted by all three departments, at the ambitious rate of 12 seminars per academic term and 6 per summer from 2003-13. These served as gateways to research for hundreds of undergraduates and graduate students as well as intimate experiments in mentoring for dozens of graduate students, postdocs and faculty. The model and seminars persist in a more mature, less formal, more flexible manner. This vertical integration reached down into High Schools where [redacted] ran a weekly afterschool mentoring program, from 2001-15, that brought Neuroscience student mentors from [redacted] College of Medicine and the University of [redacted] Health Science Center [redacted] to two struggling high schools in the Sunnyside neighborhood of Houston. Sunnyside is the least integrated neighborhood in [redacted] and the most dangerous neighborhood in Texas. This mentoring program, BrainSTEM, is flourishing and now fully student driven and managed. [redacted] was also the Founder and Director of the Gulf Coast Consortium for Theoretical and Computational Neuroscience – an organization that leverages 40 faculty from 6 neighboring institutions in the offering of a common curriculum, and the development of research, center and training programs and proposals. While at Rice [redacted] also served as Master of two residential colleges – living and working among 300 undergraduates for ten years. He co-founded [redacted] Student Taught Course program for which he developed a training course and through which he co-taught a course on Poverty in [redacted] with an undergraduate who leveraged that experience in the creation of Community Bridges, a well-funded and highly successful neighborhood partnership. [redacted] also adapted [redacted] University's Learning Assistant model to train and empower twelve undergraduates per semester to play crucial roles in the teaching of [redacted] 150 seat Introduction to Computational Engineering. [redacted] was also chosen by his peers to be the founding Director of [redacted] Center for Teaching Excellence. In Espanola he served as a weekly AVID (Advancement Via Individual Determination) tutor to 3 classes for a full year at Espanola Valley High School (EVHS). An alumna from one of his AVID classes is now an Engineering student at NNMC. She and [redacted] and a fellow EVHS alum and NNMC Engineering student have started a weekly Computing Club at EVHS, and are offering a four-week summer computing course to two classes of rising 8th graders at Pojoaque Middle School. With two other NNMC Engineering students [redacted] offered a six-week, credit bearing, academic term computing exploration to 11th and 12th graders at the McCurdy School. [redacted] moved permanently to Northern New Mexico College in January 2016 to focus on the kind of problems that INCLUDES is attempting to address.

[redacted] has served as Chair of Biology, Chemistry and Environmental Science at Northern New Mexico College since 2012. [redacted] has focused building a strong (Problem Based Learning and Problem Oriented Learning) Science undergraduate program that values basic science research as an integral component of the learning journey (performed by undergraduates). He has mentored the research of 28 NNMC undergraduates since arriving in 2010. In addition, he has recruited excellent faculty that share his philosophy of undergraduate research as a teaching tool. Together they have active participants in Friday Outreach Academies at NNMC since 2010. [redacted] has also started a student chapter of SACNAS (Society for the Advancement of Chicano / Hispanics and Native Americans in Science) at NNMC, and worked to re-shape the Biology program along two main tracks - Molecular, Cellular,

Organismal Biology and Ecology and Evolutionary Biology. [redacted] has championed the role of Biology in the Friday Outreach Academies at NNMC. He has also been successful in securing NSF funding to support students via stipends, scholarships and in network-building and pipeline construction with graduate programs at the University of New Mexico, Universities of Texas at El Paso and San Antonio, NM, University of Pittsburgh, and Michigan State University. He is trained in Neurobiology, possesses a solid background in STEM education both in Spanish and English, with particular emphasis on underserved populations.

[redacted] has served as Chair of the Department of Mathematics and Physical Science at Northern New Mexico College since 2009, supervising full-time faculty and adjuncts. His primary responsibilities are scheduling all math and physics classes, submitting book orders, leading all hiring efforts, managing the departmental budget, coordinating all assessment activity, and overseeing curriculum changes. During the last few years, Torres implemented significant changes in the developmental math sequence which entailed meeting with and training instructors. [redacted] also has regularly participated in Friday Outreach Academies at NNMC since 2010 – for which he designed most of the curriculum for the hands-on activities for middle and high school students. Titles of math sessions include "Building a Virtual Home," "Waves," "Fractals," "Building and Drawing Chemical Isomers," and "Programming with Scratch." [redacted] also serves as Institutional Coordinator for the Alliance for Minority Participation (AMP) grant which funds STEM students to perform research with faculty mentors and has mentored many undergraduates himself. He works with the Departments of Biology, Chemistry, and Environmental Science as well as the College of Engineering to recruit students and mentors for AMP projects. [redacted] also serves as Principal Investigator of the Noyce grant at NNMC which requires collaboration with the College of Education for recruitment and admission to the Alternative Licensure Program.

All three principal investigators have worked closely on community outreach matters with the highly talented, hardworking [redacted]. As program coordinator she will schedule monthly meetings of the Collective and also manage the complex scheduling, materials and promotion of all 6 programs. [redacted] will also manage the daily finances and assist the PIs in regular communication with all participants.

4. STEM Explorations, Bridge, Workshops and Collaboratives

At the inception of the pilot we will focus on the four STEM content areas in which NNMC and UNMLA faculty have both demonstrated content expertise and experience in delivery to middle and high school audiences. We begin with our perspective on each content area and then move into the specifics on the roles played by faculty and mentors as regards STEM Explorations, Bridge, Workshops and Collaboratives.

Computing Exploration. Steve Cox and Jorge Crichigno. Scratch [S] is a free online studio developed by the Lifetime Kindergarten Group in MIT's Media Lab. It encourages novices to orchestrate and animate images, sounds and objects and compose interactive games and stories. Rather than starting with small static computer programs the Scratch studio encourages novices to explore (i.e., play) its more than ten million student built projects and *remix* the ones they find most exciting, visually compelling, or challenging. We have found the text by [LEAD], with its focus on comics, games and programming and nine fully developed projects, to be the best, most structured place to start. Following the lead of the curriculum guide [BBC], we encourage *Computational Thinking* by having our students identify and reflect on the common logic constructs that support their projects. Exposure to Scratch, with its emphasis on interactive sensing and control, is excellent preparation for the LEGO software environment used to program its Mindstorm Robots. Scratch is also excellent preparation for languages used to introduce computational science and engineering in both high school and college. The debate over *the* best language for this crucial transition will be settled not by the quality of the language but by the cost of the platform and the quality of the pedagogical tools, including teacher training, developed for it. At present, in New Mexico, the language with the best tools is NetLogo, a free programming environment developed by Uri Wilensky, [Wi], [WR], at Northwestern's Center for Connected Learning and Computer-Based Modeling.

This agent-based language permits facile modeling and simulation of natural, social and engineered complex systems. NetLogo is the language chosen by the vast majority of the 50+ team entrants into the annual K12 New Mexico Supercomputing Challenge [Su] established and sustained for over 25 years by Los Alamos and Sandia National Laboratories. [redacted] organizes midterm reviews of these teams and [redacted] serves as a finalist judge. The three school systems within our collective have only rarely mustered teams. One goal of this exploration is to support teachers and students to create and sustain such teams. The NetLogo pedagogical support tools alluded to above were created Irene Lee and Maureen Psaila-Dombrowski at the Santa Fe Institute in an initiative known as New Mexico Computer Science for All, [C4]. These tools been used to train over 50 New Mexico high school teachers who have in turn offered dual (high school and college) credit to over 1000 high school students. Cox is part of a state wide effort to expand these offerings. The importance of such work was recognized this spring when President Obama announced, in an initiative called Computer Science for All, [C4a], $4 billion in funding for states, and $100 million directly for districts in his forthcoming Budget to increase access to K-12 CS by training teachers, expanding access to high-quality instructional materials, and building effective regional partnerships.

Robotics Exploration. Ivan Lopez and Ashis Nandy. Lego Mindstorm Educational Robots, [LEGO] and [KLM], are fantastic devices for shifting the Computational Thinking of the Computing Exploration from the virtual world to the material world. This coupling of light, touch and ultrasound sensors to motors on a flexible chassis of the student's design all under the control of an intuitive, graphical Scratchlike programming studio provides an excellent tool to motivate student exploration of many practical engineering principles and programming concepts. Students will be challenged to integrate hardware and software tools by developing and executing a program that rapidly guides the robot through a field of obstacles. [redacted] have considerable experience teaching Engineering via Robotics to college freshmen in ENGR 110 Introduction to Engineering at NNMC. Their course follows a problem based scheme which they have found to contribute to advances in their students' ability to think logically and critically while simultaneously increasing their interest in engineering. This activity is aligned with several other state and national level robotic initiatives to spark interest in STEM among school and college students. NNMC has hosted the regional Roborave competition for the last three years. The competition has attracted more than 200 Middle and High School students. In addition, UNMLA offers an Associate degree in Robotics, and those credits can be transferred to the Bachelor of Electromechanical Engineering Technology at NNMC. This means that the Robotics Exploration program proposed could be taken to the next level as a Dual Credit course depending on its success.

Mathematics Exploration. [redacted] Our goal is for students to experience mathematics through 3D printer design. We will use a progressive approach. Students will first work in 2D and use the free online software Desmos (www.desmos.com) to graph curves. Students can take photos of their choice, upload them to Desmos and fit the appropriate curves to the selected images. Students will discover the need for graph transformations (e.g. translation, reflection, stretching, shrinking) and will use transformations to design models to fit their images.

Student will then be taught STL (StereoLithographic) format and how it uses 3D coordinates to define the vertices of triangles which tessellate a surface. Students will form STL formats of tetrahedra, cuboids, prisms and pyramids while applying properties of triangles and computing distances in 3D. Actual 3D models of these objects will be used and built (e.g. with toothpicks and marshmallows) to help find the 3D coordinates required in the STL format. Students will compute the volumes of 3D objects to be mindful of material cost when printing their models. Subsequently, students will design and print their own small 2D simple geometrical objects with finite thicknesses (e.g. letters, 2D jewelry, key chains). Simple graph paper can be used to help define the coordinates of the faces of the objects. For more complex 3D objects, students will be introduced to simple features of the free software Blender [Bl] using guided step-by-step procedures. Students will then learn ways to become progressively more creative with Blender once they learn simple design fundamentals.

Biology Exploration. [redacted] Both faculty have engaged undergraduate STEM majors in outreach to both middle and high schools -- [redacted] through

Plant Educational Experience Research (PEER) and [redacted] through Neurobiology of the Cucaracha. Their combined Exploration offers a hands-on tour of Biology from Plants, to Insects to Muscles and Neurons. We begin with several inquiry based modules illustrating the twelve principles of plant biology. This establishes a basic understanding of cell biology and cell signaling and facilitates the jump to insects where we explore cockroach and worm physiology and electrical signaling between nerve and muscle. In particular, we record and interpret spikes from muscles in the cockroach leg and the speed at which action potentials travel in the axon of a worm. From here we explore muscle physiology in humans by recording the human electromyogram of the ulnar nerve of one subject – and using this to stimulate, or control, the arm of a second subject. The hardware for each of these experiments will come from the amazingly innovative folks at Backyard Brains, [MG], a group with strong ties to both our Math of 3D printing Exploration, [BC], and our robotics Exploration, [GRN].

The four annual **STEM Explorations** will take place concurrently at our three pilot schools: Española, Pojoaque and McCurdy, as sketched in the table below.

School	Spring		Fall	
Española	Biology	Computing	Robotics	Mathematics
Pojoaque	Mathematics	Biology	Computing	Robotics
McCurdy	Robotics	Mathematics	Biology	Computing

Table 1. Example schedule of STEM Explorations in first calendar year.

Each exploration will occupy one science/math/AVID class period over six consecutive weeks and will be staffed by one of the associated faculty members listed above and *four trained undergraduate mentors*. While the faculty members will rotate by subject, each mentor will be a *consistent presence* throughout the two full semesters. Each Exploration will be conducted in a hands-on small-group fashion with considerable independence afforded to each group. With one faculty and 4 undergraduate mentors in a class of 20 school students the mentor student ratio would be 1:4.

The **STEM Summer Bridge** will be a single (annual) 4 week summer school, held at NNMC for our three pilot schools. Each week will be devoted to one of our four STEM subjects, meeting 3 hours/day 4 days/week. Each faculty member will rotate by subject, kicking off the first day of that subject's week, while the *twelve mentors* will be a *consistent presence* throughout the full four weeks. As with Explorations the focus will be hands-on work in small groups led by a consistent mentor. With 48 school students the mentor student ratio would be 1:4.

The **STEM Community Workshop** will be a single (annual) 1 week summer school, held at NNMC for 12 pilot school teachers/administrators and rural library librarians and their affiliates. Each of the first four days will be devoted to one of our four STEM subjects and will be led by an associated faculty member. The fifth day will be devoted to building projects, solidarity and curriculum.

The **STEM Collaboratives** will be community efforts centered at the two pilot rural libraries in Dixon and El Rito. We will establish a pilot Makerspace [Co] comprising a 3D printer, Lego Robot, Backyard Brains Spiker Box and supporting materials at each library. Each library will be staffed by a local trained STEM Mentor 2 hours/week for 12 weeks/semester and 6 hours/week for 8 weeks over the summer. During the academic year each mentor will demonstrate and supervise use of the Makerspace equipment and tutor local math and science students. During the summer each mentor will turn their attention to community defined STEM challenges involving, e.g., water quality, solar energy, archeology and agriculture.

5. The Partners and Our Mentor and Protégée Training Courses

The many fruitful, meaningful collaborations within subsets of our assembled teachers and partners are largely responsible for the establishment of the programs that have attracted and supported

our current 150+ STEM undergraduates. By coalescing into our Collective of 21 we expect to draw from this cohort a Mentor Corps that can replenish itself and proceed to permanently increase the flow of our entire state's indigenous populations into STEM majors and careers.

Within the Regional Development Corporation [redacted] directs Accelerate, a workforce development program that utilizes pro-active advising, unique and effective developmental math classes, career readiness training, and paid student internships to improve graduation and job placement rates of local non-traditional students pursuing degrees in STEM in a fashion that has been found exemplary by external evaluators.

[redacted] directs the Supercomputing Challenge [Su], a statewide competition running since 1990 that annually engages teams at more than fifty New Mexico middle and high schools. The Challenge provides teacher training, expert local mentors, tools for team initiation and evaluation and significant recognition via prize money and scholarships.

[redacted] directs Café Scientifique, a program that has brought together more than 4000 local teens in an out-of-school, informal setting to learn about science and technology. This first-in-the-nation program—directed by teens and for teens—is a proven model, [MH], [HFM], for engaging teens in STEM relevant to their lives and increasing their interest in STEM careers.

Within the Center for the Education and Study of Diverse Populations [redacted] directs ENLACE, ENgaging Latino Communities for Education. This is a state funded initiative to strengthen the K-20 educational pipeline and increase opportunities for Latino/as to enter and complete college. ENLACE aims to serve as a catalyst to strengthen partnerships and create coalitions among Hispanic-serving institutions, K-12 school districts, communities, businesses, families.

[redacted] directs the Los Alamos National Laboratory Foundation Inquiry Science Education Consortium. Her staff of five provides science curriculum, equipment and comprehensive teacher training in Dulce, Española, Mesa Vista, Santa Fe, Peñasco, Pojoaque school districts, serving 11,000 students in 30 elementary schools.

[redacted] and [redacted] direct two celebrated local rural libraries in Dixon and El Rito. The Embudo Valley Library in Dixon received one of ten National Medals for Museum and Library Service in 2015. Both libraries run active tutoring programs and lecture series and serve as key, and often *sole*, points of contact between community members and the STEM world.

[redacted] and [redacted] are leaders at three local schools intent on building programs that bring their students into regular sustained contact with undergraduate role models and STEM practitioners. Sena directs First Year Programming at Española Valley High School, Pepersack is a senior science teacher at the McCurdy School and [redacted] is the curriculum specialist for the Pojoaque Valley School System.

[redacted] is an Education Specialist at the Bradbury Science Museum in Los Alamos. She is a trainer in the museum's Science Ambassador Academy, a program affiliated with the Pacific Science Center's Portal to the Public, which teaches scientists strategies to successfully communicate with and provide engaging programs for the public.

These partners are crucial to our central task of transforming our STEM majors into skilled confident mentors and in preparing our school-age youth to value and benefit from close, regular contact with these undergraduate mentors. The mentor transformation commences with the STEM Mentor Training Course and continues via ongoing reflection on their practice with their fellow mentors and faculty.

STEM Mentor Training Course. 7 weeks, 2 hours per week, 1 credit. Offered each semester at NNMC. This course will introduce our undergrads to the Collective Partners by establishing baseline science literacy of our school age youth and reflecting on local strategies and resources for its improvement. Partners will then join faculty in leading mentors in discussion of three influential texts. We will close with Partner led discussions on team and confidence building and on effective STEM communication.

Week 1. Collective take on challenges at hand. Partners [redacted] and [redacted] lead one-hour discussion on the preparation our adolescents have received, the

conceptions of STEM held by these students and strategies for filling gaps in their preparation. Partners [redacted] and [redacted] offer strategies for how best to excite, engage and empower our students in community centered STEM.

Week 2. Discussion of *Stand By Me: The Risks and Rewards of Mentoring Today's Youth*, [Rh]. Chapter 1. Inventing a Promising Future and Chapter 2. How Successful Mentoring Works.

Week 3. Discussion of *Stand By Me: The Risks and Rewards of Mentoring Today's Youth*, [Rh]. Chapter 3. The Risks of Relationships, Chapter 4. Going the Distance, and Chapter 5. Mentoring in Perspective.

Week 4. Discussion of *The Challenge to Care in Schools: An Alternative Approach to Education*, [No1]. Chapter 1. Shallow Educational Response to Deep Social Change. Chapter 2. Caring. Chapter 12. Getting Started in School.

Week 5. Discussion of *The Art of Teaching Science: Inquiry and Innovation in Middle School and High School*, [HaDi]. Chapter 7. How Adolescents Learn Science – A grounded introduction to Dewey, Bruner, Piaget, von Glaserfeld and Vygotsky.

Week 6. Discussion of *The Art of Teaching Science: Inquiry and Innovation in Middle School and High School*, [HaDi]. Chapter 8. Models of Science Teaching – Inquiry Teaching, the Role of Collaboration in Constructing Knowledge, Direct/Interactive Teaching Model.

Week 7. Collective take on challenges at hand. Partner [redacted] and his colleagues lead 1-hour discussion on how to instill self-confidence and a sense of common purpose in our students and how to navigate cultural differences. Partner Martineau and her colleagues lead 1-hour discussion on communication of STEM topics to novices.

Our school students have historically not had regular access to college age mentors and so cannot be expected to intuit the benefits that engagement with such mentors can bring. We will address this on two fronts. First, throughout each STEM Exploration the associated faculty member will (a) empower each mentor to indeed run their respective groups and (b) persuade each class member that *their* mentor is there as a role model and resource for much more than just the topic of the day. Secondly, we will work with our collective partners to prepare the ground for our mentors by bringing the proven workshop idea of Schwartz et al. [Sch] to our community:

Expanding Your Network of Caring Adults. A 7 week program, one class/week, offered each term at one school in parallel with the STEM Mentor Training Course. Provides High School Students with strategies for valuing and acquiring caring mentors via Partner led discussions.

Session 1. What is a mentor and how can mentors help me?
Session 2: Who are the adults in my life?
Session 3: How can I grow my social network?
Session 4: How can I use mentoring relationships to support me?
Session 5: How is social capital influenced by power and privilege?
Session 6: How can I connect with mentors next year?
Session 7: Who can support me during the transition to college (from home and on campus)?

These are subjects that Partner [redacted] and his colleagues already broach in their work with our pilot schools. The cooperation of STEM faculty and fellow Collective Partners will serve to reinforce their work and offer school students concrete examples. In particular, the benefit of running this workshop in parallel with the STEM Mentoring Course is that at their conclusion we may schedule a Network Night where prepared school students mix with freshly trained college mentors and faculty and partners.

6. Evaluation and Dissemination

We argued in section 2 that a quality undergraduate mentoring program *can* improve learning for both mentors and protégées while raising the social capital of allied school teachers. Quantitative **Evaluation** is the sole means of arriving at a quality program. PI [redacted], as well as partners [redacted] and [redacted], have considerable experience working with evaluators of local STEM

workforce grants and programs. The collective will convene in October of 2016 to cull and sharpen the eleven common measures, P1-11, of youth protégée attitudes and performance, eleven common measures, M1-11, of undergraduate mentor attitudes and performance and three common measures, T1-3, of teacher social capital – producing pre- and post-evaluation instruments, for each participating population, for each of our six programs. These agreed upon measures, will then determine, through the counsel of [redacted] and [redacted] the desired qualities and role of the external evaluator, to be hired by December 2016.

We will use the outcomes of the initial spring, summer and fall programs to guide changes in the key variables of our first year programs. The key to achieving desired positive outcomes lies in the creation of bond-forming mentor/protégée relationships, and the two key variables, under our control, for facilitating such bonds are the **mentor/protégée ratio** and the **duration** of the relationship. We will assess the degree of bond forming by protégée responses to measures P6-8 as well as through two additional questions of participating faculty and undergraduates following each STEM exploration:

I1. The level of engagement of student X with STEM subject Y was (low, moderate, high).
I2. The level of interaction between student X and their mentor was (low, moderate, high).

Responses to I1 will facilitate modification of the STEM Explorations while responses to I2 will facilitate faculty feedback to their associated undergraduate mentors. The latter will indeed serve to improve individual mentor/protégée relationships. The totality of responses to P6-8 and I1-2, as early as the close of Spring 2017 and surely by the close of Fall 2017, will give us the information we need to make intelligent, program wide, adjustments of the mentor/protégée ratio and the duration of their relationship. The ratio can be reduced by working in smaller classes or, if this is not possible, by working with fewer schools. The duration may be increased by efforts to fill the many week(s) long breaks that riddle our school calendars. Although perhaps helpful in breaking the perceived monotony of academics these interruptions are damaging to the nascent relationships with caring mentors. Between August and May these smaller gaps can be filled by mentors making time for informal protégée mash-ups of computers, robots, cockroaches and 3D printers. In the larger break between May and August these mash-ups may take the form of individual mentor directed research projects or mentored teams formed to prepare for the upcoming Supercomputing Challenge, RoboRave, or Brain Bee.

Regarding **Dissemination** we will compile printed STEM Exploration, Workshop and Mentor Training Manuals, to serve as preparation for our own mentors entering the classroom as well as templates for our pilot schools as we attune the content to their needs. We will publish these as supplementary materials to our assessment, in scholarly journals, of the collective impact of our mentoring program on school students, college students, and school teachers – with emphasis on a quantitative predictive model, *a la* Figures 2 and 3 with edge weights as in [RGR], that tightly couples these three populations. We will, in addition, follow the StriveTogether practice of disseminating an annual report card on the STEM preparedness of our school and college students along with an annual assessment of the successes and failures our collective attack.

7. Broader Impact

The broader impact of our project lies in its potential to focus the talents and energies of a diverse collective of community stakeholders on the empowerment of its local college population to address and solve a STEM disparity that bears directly on the community's well-being – in a fashion that is generalizable to other marginalized communities. Our STEM Mentor Collective is generalizable because with only a moderate initial investment our disseminated 6-program infrastructure supports the growth and maintenance of a realistic homegrown mentor corps.

8. Timeline

Oct-Dec 2016. Begin monthly meetings of Collective. Recruit potential mentors. Offer 7-week Mentor Training Course at NNMC. Offer Expanding Your Network of Caring Adults (EYNoCA) at one pilot school. Develop STEM evaluation instruments. Scope and hire the external evaluator. Coordinate, tune and schedule STEM Explorations and STEM Collaboratives for coming spring semester and summer.
Spring 2017. Pilot two STEM Explorations at three schools per Table 1 and two STEM Collaboratives at two libraries. Offer STEM Mentor Training Course and EYNoCA at second school. Evaluate all piloted programs. Interrogate data for impact of Fall mentor training and EYNoCA. Offer feedback to faculty and undergraduate mentors.
Summer 2017. Offer 4-week summer bridge for students, one-week community workshop and two eight-week STEM Collaboratives. Coordinate, tune and schedule STEM Explorations and STEM Collaboratives for coming fall semester. Evaluate all piloted programs. Offer feedback to faculty and undergraduate mentors.
Fall 2017. Pilot two additional STEM Explorations at three schools and continue two STEM Collaboratives at two libraries. Offer STEM Mentor Training Course and EYNoCA at third school. Evaluate all piloted programs. Offer feedback to faculty and undergraduate mentors. Interrogate data for impact of spring mentor training and EYNoCA. Assess program-wide strength of mentor/protégée relationships and adjust ratios and durations per section 6. Coordinate, tune and schedule STEM Explorations and STEM Collaboratives for coming spring semester and summer. Prepare and disseminate first annual report card.
Spring 2018. Offer two STEM Explorations and two STEM Collaboratives. Offer STEM Mentor Training Course and EYNoCA at first school. Evaluate all piloted programs. Interrogate data for impact of Fall mentor training and EYNoCA. Offer feedback to faculty and undergraduate mentors.
Summer 2018. Offer 4-week summer bridge for students, one-week community workshop and two eight-week STEM Collaboratives. Coordinate, tune and schedule STEM Explorations and STEM Collaboratives for coming fall semester. Evaluate all piloted programs. Offer feedback to faculty and undergraduate mentors.
August-Oct 2018. Offer one STEM Explorations at three schools and continue two STEM Collaboratives at two libraries. Evaluate all piloted programs and prepare manuscripts for publication. Prepare and disseminate second annual report card. Reach out to new potential Collective regional partners in Los Alamos, Ojo Caliente, Santa Fe, Taos, Peñasco and Tierra Amarilla to increase the number of teens impacted.

9. Results from Prior NSF Support

NSF DMS 1122455, Dendritic Processing of Topographic Information in a Collision Detecting Neuron, Nov 2011 – Nov 2014 (plus three-year no-cost extension), $275,599 total award. Collaborative proposal with [redacted] College of Medicine. [redacted]University PI:[redacted]. Products [DSC].

NSF DUE 0806469, S-STEM: SCHLR SCI TECH ENG & MATH, Biological Sciences; 08/01/2008 - 12/31/2013 (plus one-year no-cost extension); PI: Ulises Ricoy; $598,000 total award; $10,000 per recipient/year; 28 scholarship recipients; 24 graduated; 86% graduation rate; 4 recipients left the program.

NSF DUE 1035465, ROBERT NOYCE SCHOLARSHIP PROGRAM; 10/01/10 - 09/30/15 (plus one-year no-cost extension); PI: [redacted]; $1,152,055 total award; $12,000 per recipient/year; 18 scholarship recipients to date; 9 have graduated to date; 50% graduation rate to date; 1 recipient has left the program to date.

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SUMMARY PROPOSAL BUDGET

YEAR 1

	FOR NSF USE ONLY		
ORGANIZATION **Northern New Mexico College**	PROPOSAL NO.	DURATION (months)	
		Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR [redacted]	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. [redacted]	0.00	0.00	1.00	[redacted]	
2. [redacted]	0.00	0.15	0.00	[redacted]	
3. [redacted]	6.00	0.00	0.00	[redacted]	
4. [redacted]	0.00	0.00	0.04	[redacted]	
5. [redacted]	0.00	0.15	0.05	[redacted]	
6. (**5**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.28	1.11	[redacted]	
7. (**10**) TOTAL SENIOR PERSONNEL (1 - 6)	6.00	0.58	2.20	**47,485**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	6.00	0.00	0.00	**0**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**28**) UNDERGRADUATE STUDENTS				**21,168**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**12**) OTHER				**7,200**	
TOTAL SALARIES AND WAGES (A + B)				**75,853**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**18,320**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**94,173**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				**4,825**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ **0** 2. TRAVEL **0** 3. SUBSISTENCE **0** 4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**4,300**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**12,000**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**16,300**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**115,298**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **Fringe Benefits (Rate: 30.0000, Base: 18320) (Cont. on Comments Page)**					
TOTAL INDIRECT COSTS (F&A)				**34,590**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**149,888**	
K. SMALL BUSINESS FEE				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**149,888**	

M. COST SHARING PROPOSED LEVEL $ **0**	AGREED LEVEL IF DIFFERENT $		
PI/PD NAME [redacted]	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* [redacted]	Date Checked	Date Of Rate Sheet	Initials - ORG

 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

Other Senior Personnel

Name - Title	Cal	Acad	Sumr	Funds Requested
[redacted] - Faculty Mentor	0.00	0.00	0.06	500
[redacted] - Faculty Mentor	0.00	0.13	0.00	900
[redacted] - Co-PI	0.00	0.00	0.50	2950
[redacted] Co-PI	0.00	0.00	0.50	2813
[redacted] - Faculty Mentor	0.00	0.15	0.05	1200

** I- Indirect Costs
Other Direct Costs (Rate: 30.0000, Base 16300)
Other Personnel (Rate: 30.0000, Base 28368)
Senior Personnel (Rate: 30.0000, Base 47485)
Travel (Rate: 30.0000, Base 4825)

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION **Northern New Mexico College**				FOR NSF USE ONLY PROPOSAL NO.	DURATION (months) Proposed / Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR [redacted]				AWARD NO.	
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. [redacted]	0.00	0.00	1.00	[redacted]	
2. [redacted]	0.00	0.15	0.00	[redacted]	
3. [redacted]	6.00	0.00	0.00	[redacted]	
4. [redacted]	0.00	0.00	0.04	[redacted]	
5. [redacted]	0.00	0.15	0.05	[redacted]	
6. (**5**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.28	1.11	**8,363**	
7. (**10**) TOTAL SENIOR PERSONNEL (1 - 6)	6.00	0.58	2.20	**47,485**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00	**0**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**28**) UNDERGRADUATE STUDENTS				**21,168**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**12**) OTHER				**7,200**	
TOTAL SALARIES AND WAGES (A + B)				**75,853**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**18,320**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**94,173**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				**4,825**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ **0** 2. TRAVEL **0** 3. SUBSISTENCE **0** 4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**4,300**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**12,000**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**16,300**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**115,298**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **Fringe Benefits (Rate: 30.0000, Base: 18320) (Cont. on Comments Page)**					
TOTAL INDIRECT COSTS (F&A)				**34,590**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**149,888**	
K. SMALL BUSINESS FEE				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**149,888**	
M. COST SHARING PROPOSED LEVEL $ **0**	AGREED LEVEL IF DIFFERENT $				
PI/PD NAME [redacted]				FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION	
ORG. REP. NAME* [redacted]				Date Checked / Date Of Rate Sheet / Initials - ORG	

 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET COMMENTS - Year 2

Other Senior Personnel

Name - Title	Cal	Acad	Sumr	Funds Requested
[redacted] - Faculty Mentor	0.00	0.00	0.06	500
[redacted] - Faculty Mentor	0.00	0.13	0.00	900
[redacted]- Co-PI	0.00	0.00	0.50	2950
[redacted] Co-PI	0.00	0.00	0.50	2813
[redacted] - Faculty Mentor	0.00	0.15	0.05	1200

** I- Indirect Costs
Other Direct Costs (Rate: 30.0000, Base 16300)
Other Personnel (Rate: 30.0000, Base 28368)
Senior Personnel (Rate: 30.0000, Base 47485)
Travel (Rate: 30.0000, Base 4825)

SUMMARY PROPOSAL BUDGET

Cumulative

		FOR NSF USE ONLY		
ORGANIZATION **Northern New Mexico College**		PROPOSAL NO.	DURATION (months)	
			Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR [redacted]		AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. [redacted]	0.00	0.00	2.00	[redacted]	
2. [redacted]	0.00	0.30	0.00	[redacted]	
3. [redacted]	12.00	0.00	0.00	[redacted]	
4. [redacted]	0.00	0.00	0.08	[redacted]	
5. [redacted]	0.00	0.30	0.10	[redacted]	
6. (**5**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.56	2.22	**16,726**	
7. (**10**) TOTAL SENIOR PERSONNEL (1 - 6)	12.00	1.16	4.40	**94,970**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	6.00	0.00	0.00	**0**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**56**) UNDERGRADUATE STUDENTS				**42,336**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**24**) OTHER				**14,400**	
TOTAL SALARIES AND WAGES (A + B)				**151,706**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**36,640**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**188,346**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				**9,650**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ **0** 2. TRAVEL **0** 3. SUBSISTENCE **0** 4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**8,600**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**24,000**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**32,600**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**230,596**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**69,180**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**299,776**	
K. SMALL BUSINESS FEE				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**299,776**	

M. COST SHARING PROPOSED LEVEL $ **0**	AGREED LEVEL IF DIFFERENT $		
PI/PD NAME [redacted]	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* [redacted]	Date Checked	Date Of Rate Sheet	Initials - ORG

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Budget Justification

(A) Senior Personnel

***PI and Co-PI's*:**

<u>Compensation for the Principal Investigator,</u> [redacted] whose annual salary is [redacted] on a 9-month contract at Northern, will have a 1.0-Summer month salary o[redacted] <u>in Year 1</u> and <u>Year 2</u>. Over the course of the two-year grant, [redacted] will serve as the Principal Investigator and will be responsible for project oversight, implementation, reporting, overall monitoring, and managing of the Collective, including working closely with the two Co-PI's, the project Coordinator, student mentors, faculty mentors, high school and middle school teachers and students. In addition, [redacted] will be responsible for the coordination and direct management of the Computing Exploration program at three schools; and will be responsible for instructing a one-week summer computing program for school teachers an librarians. This level of administrative commitment requires 1.0-Summer month compensation. **Total PI compensation is $13,444 for the two-year period.**

[redacted], Co-PI, whose annual salary is [redacted] on a 10-month contract at Northern, will have a 0.5-Summer month salary of [redacted] <u>in Year 1</u> and <u>Year 2</u>. Over the course of the two-year grant, Dr. Ricoy will be responsible for the coordination and direct management of the Biology Exploration program at three schools. In addition, [redacted] will be responsible for instructing a one-week summer biology program for school teachers and librarians. This level of coordination and instructional commitment requires a 0.5-Summer month salary. **Total Co-PI compensation is $5,900 for the two-year period.**

[redacted] Co-PI, whose annual salary is [redacted] on a 10-month contract at Northern, will have a 0.5-Summer month salary of [redacted] <u>in Year 1</u> and <u>Year 2</u>. Over the course of the two-year grant, Dr. Torres will be responsible for the coordination and direct management of the Math Exploration program at three schools. In addition, [redacted] will be responsible for instructing a one-week summer math program for school teachers and librarians. This level of coordination and instructional commitment requires a 0.5-Summer month salary. **Total Co-PI compensation is $5,626 for the two-year period.**

***Faculty and Other Senior Associates*:**

<u>Compensation for Faculty Mentors in Year 1 and Year 2</u>: Six Faculty will serve as Faculty Mentors in three schools during the academic year and/or during the summer. The six Faculty Mentors are [redacted] and [redacted] Faculty Mentors will be compensated at a rate of $25/hour, plus 32% benefits. During the summer, four Faculty Mentors will work for 3 hours/week for 4 weeks and will receive a stipend of $300 each. The total stipend amount for four summer Faculty Mentors = $300 x 4 = $1,200/year. During the academic year, four Faculty Mentors will work for 2 hours/week for 18 weeks and will receive a stipend of $900 each. The total stipend amount for four academic year Faculty Mentors = $900 x 4 = $3600/year. <u>The annual Faculty Mentor stipend = $4800</u>. **Two year Faculty Mentor compensation = $9600.**

<u>Compensation for one Faculty Instructor for each Teacher Workshop in Year 1 and Year 2</u>: One Faculty member will support the PI and Co-PI's in the instruction of a one-week summer STEM

exploratory workshop developed to train high school and middle school teachers in the four STEM subjects. This Faculty Instructor will be compensated at a rate of $25/hour, plus 32% benefits. The Faculty Instructor will work for 8 hours/day for 1 day for a total stipend of $25 x 8 = $200/year. **The two year Teacher Instructor compensation = $400.**

A Senior Associate, [redacted], will serve as the Project Coordinator, and will be compensated on a 50% FTE basis on an annual FTE salary of [redacted] to support the PI and Co-PI's in the daily coordination of members of the Collective in their respective roles. The Project Coordinator will schedule monthly meetings of the Collective and also manage the complex scheduling, materials and promotion of all 6 programs. The Project Coordinator will also manage the daily finances and assist the PIs in regular communication with all participants. The Project Coordinator will report directly to the PI. For this level of effort, the Project Coordinator will receive $30,000 per year plus 32% benefits in Year 1 and Year 2 for a **two-year project total compensation of $60,000.**

The Total Senior Personnel Salaries = $47,485/year.

The Two Year Senior Personnel Total = $94,970.

(B) Other Personnel Costs:
Undergraduate Student Stipends: Compensation for 14 undergraduate students during the academic year and 14=12+2 during the summer in Year 1 and 2. This budget includes a stipend of $648 per student ($18/hour x 2 hours/week x 18 weeks) for the academic year and $864 per student ($18/hour x 12 hours/week x 4 weeks) during the summer. 12 students will support STEM Explorations and Bridge while 2 students will support STEM Collaboratives. The annual total stipend for the academic year is $9072 and for the summer is $12,096 for a total annual student mentor stipend of $21,168. **The two year student mentor stipend = $42,336.**

Other - Community Teacher/Librarian Stipends: Twelve partner school Teachers and/or partner library workers will each be provided a $600 stipend ($20/hour x 30 hours) to participate in a 30-hour workshop (6 hours/day for five days) in a STEM Community Workshop in Year 1 and Year 2. The annual stipend total for 12 Teachers = $7,200. **The two year total Teacher stipend = $4,800**

The Total Other Personnel Salaries = $28,368/year.

The Two Year Other Personnel Total = $56,736.

(C) Fringe Benefits:

- A 32% fringe benefit rate is included for Senior Personnel in Year 1 and Year 2. Total Senior Personnel salaries =$47,485 x 32% = $15,196.
- A 14% fringe benefit rate for Other Personnel -Teacher stipends is included in Year 1 and Year 2. Total Other Personnel - Teacher stipends = $7,200 x 14% = $1,008
- A 10% fringe benefit rate for the undergraduate student mentors is also included in Year 1 and Year 2.

Year 1 and Year 2 Total Fringe Benefits is $18321/year.
The Total Fringe Benefits for Year 1 and Year 2 is $36642.

(E) Travel:
Year 1 and Year 2: The PI and one Co-PI will travel to Washington, DC, for the annual NSF INCLUDES Meeting: $1750 each x 2 = $3,500 ($600 flight + 3 nights hotel at $250/night [$750] + $50/day per diem x 4 days [$200] + $200 ground transportation (travel from Dixon/Espanola to ABQ airport, airport parking, taxis in DC]. In addition, the PI and to two Co-PI's will travel to Albuquerque, NM, for the Mentor Conference @ $442 each x 3 = $1325 (175 miles round trip from Espanola, NM @0.32/mile + $90/night hotel x 2 nights + $35/day per diem x 3 days + $85 registration fee) to attend an annual Mentor's Conference. Annual travel costs = $4,825.

The Total Travel Costs for Year 1 and Year 2 = $9,650.

(G) Other Direct Costs:
Materials and Supplies for Year 1 and Year 2: Robots, 3D Printers, Biology Backyard Brains Kits and general supplies including printer ink, paper, and basic office supplies = $4,300 per year x 2 = **$8,600 for the two year project period.**

Consultant Services for Year 1 and Year 2: Project External Evaluator @ $12,000 per year = **$24,000 for the two year project period.**

The Total Other Direct Costs for Year 1 and Year 2 is $32,600.

(I) Indirect costs: The Northern F&A rate issued by the Department of Health and Human Services is 30% of the Direct Costs.

Direct Costs in Year 1 and Year 2 = $115,299 x 30% = $34,590 in Indirect Costs/year

Total Indirect Costs in Year 1 and Year 2 = $69,180.

DIRECT AND INDIRECT COSTS IN YEAR 1 AND YEAR 2 = $149,889/YEAR.

TOTAL DIRECT AND INDIRECT COSTS FOR THE TWO YEAR PROJECT PERIOD = $299,776.

Facilities, Equipment and Other Resources

I. Support Facilities and Equipment

A. Northern New Mexico College (Northern)

1) Research Equipment and Support Facilities at Northern New Mexico College

Northern supports two campuses, each equipped with basic research facilities that encourage undergraduate research experiences (URE) in STEM. The Espanola Campus serves as the main campus for the INCLUDES program and houses the following STEM programs:

Engineering: The Engineering facility for research and teaching is the brand new, state-of-the-art Solar Energy Research Park and Academy (SERPA) building. SERPA which, also hosts the College of Engineering and Technology (CET), is equipped with modern facilities and laboratories specifically designed for undergraduate use, including the:

- Mechanical Engineering Laboratory
- Solar Energy Laboratory
- Machine Shop
- Design and Drafting Laboratory
- Computer Programming Laboratory
- Instrumentation Laboratory
- Peer Tutoring and Learning Center
- Student Lounge and Study Area
- Student Computer Lab

Biology and Chemistry: Facilities reside in four General Education laboratories. Four of these labs are dedicated to faculty-directed URE initiatives. Throughout the academic year and summer, undergraduate students are involved in experiments and training with basic research in the following laboratories and research settings:

- Molecular and Cell Biology Laboratory
- Developmental Biology Laboratory
- GE Chemistry & Biochemistry Facility
- Microbiology/Tissue Culture Facility
- Office Space and Support Laboratories

Environmental Science: Facilities reside in the General Education and High Technology Building laboratories. All of these labs are dedicated to faculty-directed URE initiatives. Throughout the academic year and summer, undergraduates are involved in experiments and training with basic research in the following laboratories and research settings:

- Environmental Monitoring and Natural Resource Management Facilities

Mathematics and Science: Facilities reside in the High Technology Building laboratories. Two of these labs are dedicated to faculty-directed undergraduate research experience initiatives. Throughout the academic year and summer months, undergraduates are involved in experiments and training in basic research in the following laboratories and research settings:

- Aguila Parallel Supercomputer
- High Tech 101
- ADM Conference Room

2) Educational Environment and Facilities on the Espanola Campus

The Northern New Mexico College Espanola Campus is a comprehensive campus with state-of-the-art computer and laboratory facilities for classroom instruction and a fully equipped Student Support Services Center, which includes a computer lab and tutorial assistance that will be available to all INCLUDES participants. A newly built library contains spacious and light-filled private and open rooms where students can study individually or engage in study groups.

Many students arrive at Northern with math and writing deficiencies and require extensive remediation and support. The College houses specialized tutoring centers, which will be made available to all, INCLUDES student participants, including:

- Math Tutoring Center – Housed in the new and state-of-the-art High Tech building, the Math Center provides computers loaded with necessary software and tutoring for all levels of math to all students, free of charge.
- Writing Center – Housed in the main General Education Building, The Writing Center provides computers, printers and comprehensive tutoring and writing support to all students, free of charge.
- On-site Counseling Services are available to students who wish to speak to a professional counselor about personal, work and school related issues, free of charge.

In addition to these and other specific departmental resources (such as the Engineering Tutoring Center), Northern also supports a college-wide Accessibility Resource Center, the Educational Opportunity Center and a Veterans Resource Center.

B. Public Schools

The equipment and facilities at three pilot schools will be used for the two-year period of this project. Facilities at **Espanola Valley High School**, **McCurdy Charter High School** and **Pojoaque Valley High School** will host four annual STEM Explorations concurrently. Each exploration will occupy one science/math/AVID class period over six consecutive weeks and will be staffed by one of the associated faculty members and four trained undergraduate mentors. Although faculty members will rotate by subject, each mentor will be a consistent presence throughout two full semesters. Each Exploration will be conducted in a hands-on small-group fashion with considerable independence afforded to each group.

C. Rural Libraries

The **Embudo Valley Library in Dixon**, NM, and the **El Rito Library in El Rito**, NM, are two rural libraries in whose facilities a pilot Makerspace, comprising a 3-D printer, Lego Robot, Backyard Brains Spiker Box and supporting materials, will be housed. Each library will provide a local trained STEM Mentor who, during the summer, will turn their attention to community defined STEM challenges involving issues such as water quality, solar energy, archeology and agriculture. During the academic year each mentor will demonstrate and supervise use of the Makerspace equipment and tutor local math and science students.

III. Other Resources

Partners and Mentors

The many fruitful, meaningful collaborations within subsets of our assembled teachers and partners are largely responsible for the establishment of the programs that have attracted and supported our current 100+ STEM undergraduates. By coalescing into our Collective of 20 we expect to draw from this cohort a Mentor Corps that can replenish itself and proceed to permanently increase the flow of our entire state's indigenous populations into STEM majors and careers.

These partners are crucial to the central task of transforming STEM majors into skilled confident mentors and in preparing school age youth to value and benefit from close, regular contact with undergraduate mentors. The individuals listed below will not receive funding for their involvement in this project and are thus 'Other Resource's:

[redacted]s an Education Specialist at the Bradbury Science Museum in Los Alamos. She is a trainer in the museum's Science Ambassador Academy, a program affiliated with the Pacific Science Center's Portal to the Public, which teaches scientists strategies to successfully communicate with and provide engaging programs for the public.

[redacted] within the Regional Development Corporation directs Accelerate, a workforce development program that utilizes pro-active advising, unique and effective developmental math classes, career readiness training, and paid student internships to improve graduation and job placement rates of local non-traditional students pursuing degrees in STEM in a fashion that has been found exemplary by external evaluators.

[redacted] directs the Supercomputing Challenge [Su], a statewide competition running since 1990 that annually engages teams at more than fifty New Mexico middle and high schools. The Challenge provides teacher training, expert local mentors, tools for team initiation and evaluation and significant recognition via prize money and scholarships.

[redacted] directs Café Scientifique, a program that has brought together more than 4000 local teens in an out-of-school, informal setting to learn about science and technology. This first-in-the-nation program—directed by teens and for teens—is a proven model, [MH], [HFM], for engaging teens in STEM relevant to their lives and increasing their interest in STEM careers.

[redacted] within the Center for the Education and Study of Diverse Populations directs ENLACE, ENgaging LAtino Communities for Education. This is a state funded initiative to strengthen the K-20 educational pipeline and increase opportunities for Latino/as to enter and complete college. ENLACE aims to serve as a catalyst to strengthen partnerships and create coalitions among Hispanic-serving institutions, K-12 school districts, communities, businesses, and families.

[redacted] directs the Los Alamos National Laboratory Foundation Inquiry Science Education Consortium. Her staff of five provides science curriculum, equipment and comprehensive teacher training in Dulce, Española, Mesa Vista, Santa Fe, Peñasco, Pojoaque school districts, serving 11,000 students in 30 elementary schools.

[redacted] and [redacted] direct two celebrated local rural libraries in Dixon and El Rito. The Embudo Library in Dixon received one of ten National Medals for Museum and Library Service in 2015. Both libraries run active tutoring programs and lecture series and serve as key, and often *sole*, points of contact between community members and the STEM world.

[redacted], [redacted] and [redacted] are leaders at three local high schools intent on building programs that bring their students into regular sustained contact with undergraduate role models and STEM practitioners.

IV. Research Oversight, Compliance and Safety

Northern and its partnering institutions maintain a commitment to the highest standards of integrity in all aspects of their educational missions. This includes adherence to standards of ethics in all areas of teaching, research and mentoring activities undertaken by faculty, staff and students. Northern and its partners also maintain compliance with federal, state, and institutional regulations and policies. Northern, as the lead institution, its administration and faculty leaders provide oversight over the responsible conduct of research and ensure conformity with regulatory requirements relating to research, including humane treatment of human and animal subjects. Towards this end Northern maintains an Institutional Review Board (IRB) with that reviews all proposals that require any aspect of human surveys or sampling. All units within Northern interface with the institution's safety and security committee to assure adherence to OSHA and other safety processes, protocols and practices, including providing requisite training and related educational programs for all employees.

Data Management Plan

Types of data collected: The only data will be collected through the course of the Northern New Mexico STEM Mentor Collective is:

Student, Teacher and Faculty participant surveys – including self reported student academic and attendance data.

Data Standards: Text data will be saved as MS Word files and pdf documents. Any tabular data collected will be in Excel spreadsheets or data tables and saved as .xlsx files for long-term accessibility.

Policies for Access and Data Sharing: Only the PI and the program evaluator will have access to the raw participant data, which will be made anonymous. The members of the Collective will have access only to data summarized by the evaluator. All participant data will be stored encrypted and on a password protected computer belonging to the evaluator. **No personal student information (including name, email, address, phone or student ID) will become available in any form.**

Summary data will also be made available annually through the Northern New Mexico STEM Mentor Collective Report Card.

There will be no fee for data and information sharing. All reports will be accessible on the Northern New Mexico STEM Mentor Collective website and the PI will be responsive to further requests for data from researchers and the public. Northern New Mexico College IRB protocols will be followed with respect to data collection and accessibility, including anonymization of human subjects.

Policies for Re-Use, Redistribution: NNMC will apply for and employ a Creative Commons CC BY license. This license will allow for greater use of reports and information, while requiring users to cite NSF and this project as original authors.

Plans for Archiving & Preservation: This Pilot Program will not require special long-term storage facilities other than the Northern New Mexico College web-server. Data will be made available on the Northern New Mexico STEM Mentor Collective website for two years after the project end-date. All reports and data will be stored for seven years in the NNMC data storage system. After that date, original data and reports will be archived in the NNMC library archival system.

Other policies related to confidential information include the following:

- No personal student information (including name, email, address, phone or student ID) will become available to the public, except in cases where materials are published and informed consent has been obtained.
- All informed consent protocols and confidentiality procedures will be observed.
- Personal student information in electronic form will be stored and backed up in encrypted files in local (Espanola Campus), secure hard drives with no access to the public. Paper materials from students will remain stored in the STEM Department Archives.